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NATO M&S Conference Paris

NATO-PFP/Industry/National Modelling and Simulation Partnerships

Working with Industry -
The UK MoD Experience

Andy Fawkes

Head of the Synthetic Environments Co-ordination Office

UK Ministry of Defence

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Notes for Slide 1

Good morning Ladies and Gentlemen. I am grateful for the opportunity to speak to you about how we have progressed the exploitation of synthetic environments together with Industry. This is of course very much in line with the theme of this Conference.

Scope of Presentation

- UK Approach to Synthetic Environments and M&S
- Why Work with Industry?
- Historical Perspective
- Current Arrangements
- Summary

Notes for Slide 3

In my presentation I will first explain the UK Ministry of Defence approach to Synthetic Environments and modelling and simulation in general. I will then explain why the UK MoD and Industry has considered it beneficial to work closely in this field. I will support this with describing our record of working together since 1995. I will conclude by reviewing our current co-operative arrangements and providing a summary.

UK Defence Environment

Operational Context

- Uncertain Threats
  - Wide Range of Threat Capabilities
  - World-wide Threats
  - Asymmetric Threats
  - Speed of Response

- Joint/Multi-National Operations Increasingly Important

Delivery of Capability

- Equipment
  - Smart Acquisition
    - Faster, Cheaper, Better
    - More Collaborative Working
  - Network Enabled Capability *

- People
  - Pressures on Training
    - "Live" opportunities
    - Time for training
  - More Collective and Deployable Training

Notes for Slide 5

So what firstly is the current UK Defence Environment that is driving our approach to Synthetic Environments?

Here are some of the main drivers...

UK Defence Environment

- The defence world is becoming at the same time more connected - largely through digital technology - and more uncertain.

- We therefore need to better understand the interactions between systems and processes and be more responsive to a continuing changing world.

Notes for Slide 7

We can see that the connections or interrelationships within Defence are becoming both more complex and more important but this is within a more uncertain strategic environment. Partnerships or collaboration between the stakeholders, whether Allies or Industry, is therefore becoming more important. We also need to be more responsive.

UK Defence Environment

- How can modelling and simulation or synthetic environments help?

Notes for Slide 9

So how can modelling and simulation or synthetic environments help?

Defence Modelling & Simulation

- UK MoD and Industry spend £100m's per annum on modelling and simulation (M&S) (together with UK Allies)

- Applications
  - Planning
  - Research
  - Operational Analysis
  - Prototyping
  - Test & Evaluation
  - Manufacturing
  - Acceptance
  - Individual Training
  - Collective Training
  - Mission Rehearsal
  - Command Support

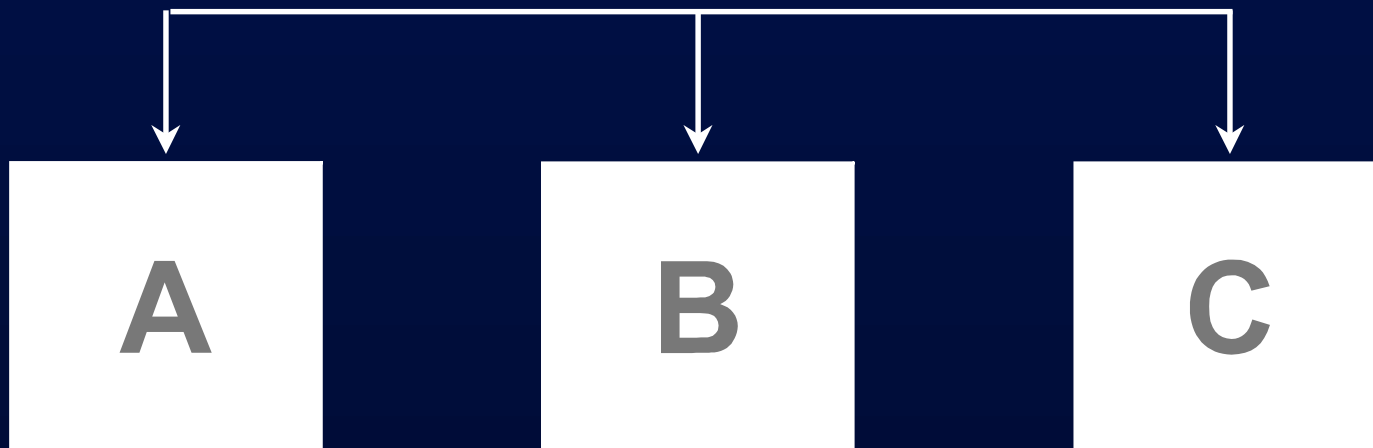**M&S Technology is Advancing Rapidly**

Notes for Slide 11

We already of course spend a great deal of resources in both Government and Industry on modelling and simulation or M&S to help us understand and rehearse. M&S is exploited across all Defence Activities.

Extending the Use of Modelling & Simulation Across Defence Processes and Stakeholders

Notes for Slide 13

However, to understand the interactions between M&S, and hence the Defence Activities they represent, it is becoming increasingly important to be able to make M&S interact with themselves and indeed with people and real equipment.

Synthetic Environments - SECO Working Definition

Synthetic Environment

– A computer-based representation of the real world, usually a current or future battle space, within which any combination of 'players' may interact. The 'players' may be computer models, simulations, people or instrumented real equipments.

Notes for Slide 15

This has led us in the UK to define Synthetic Environments in the following way. The key word is "interact", this might be through electronic means or not.

Synthetic Environments - Offer

- By allowing discrete M&S to interact, taking a through-life approach to M&S, and seeking M&S re-use, SEs can:

  - facilitate a collaborative and systems-based approach to working,

  - expand operational training environments and

  - reduce costs for UK MoD, Industry and our Allies.

- Much of the full value of SEs comes through collaborative, agreed approaches to standards, data management, processes, etc.

3-17

Notes for Slide 17

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The Challenge of Synthetic Environments

- Technology
- Culture
- Capturing Requirements
- Stovepipe Funding
- Intellectual Property Rights (IPR)
- Security
- Avoiding Duplication
- Achieving Consistency
- Retention of Expertise

Notes for Slide 19

There of course a number of challenges - but these reflect the opportunities presented by synthetic environments to challenge the way we do business.

Current SE Examples

- Acquisition
  - Joint Strike Fighter (JSF)/JCA,
  - Future Offensive Air System (FOAS),
  - Ground Based Air Defence (GBAD),
  - Future Carrier,
  - Future Integrated Soldier Technology (FIST),
  - Watchkeeper UAV.

- Operational Training
  - Combined Arms Tactical Trainer (CATT)
  - Medium Support Helicopter Training Facility (MSHTF)
  - Mission Training through Distributed Simulation (MTDS)
  - Maritime Composite Training System (MCTS)
  - NATO Pathfinder

Notes for Slide 21

The UK has now embraced using SEs in many of its current major Acquisition and Training projects - but it is still seen as something new and has not become an automatically accepted approach universally.

Of course all these projects are delivered through Industry in one shape or form. This leads me to discussing why we must work closely with Industry.

Why work with Industry?

- From earliest days both Industry and MoD realised that SEs had the potential to strengthen partnerships

- Working with Industry offers the potential also for greater cost effectiveness and consistency through:

  - the sharing of data and knowledge

  - working to common agreed standards

  - better mutual understanding of defence processes

- It is primarily only through Industry that we can procure (front line or training) equipment

Notes for Slide 23

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• better mutual understanding of defence processes

It is primarily only through Industry that we can procure (front line or training) equipment

These are fine words but I now want to demonstrate that there can be real advantages in partnerships by tracing the history of how we have worked together with Industry in the UK.

Working with Industry & Academia - Historical Perspective

Building a Foundation....

Notes for Slide 25

From 1993 series of meetings held between MoD and Industry under the SERIN banner (Synthetic Environment Research INitiative).

Number of conferences held in the mid-1990's under sponsorship of bodies such as the Defence Manufacturer's Association (DMA) and RUSI. Emphasised the message that SE had much to contribute to Equipment Acquisition.

Following a 1993 Shrivenham conference MoD established a senior (3*) forum - the SE Policy Steering Group to take forward SE on a corporate basis. There was a strong consensus that a UK national equivalent was required to provide a high level (board level) focus.

Led to formation of SE Management Board in 1995.

Working with Industry & Academia - Historical Perspective - 1

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Notes for Slide 27

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Working with Industry & Academia - Historical Perspective - 2

- SEMB agreed there was a need to prove both the technology supporting SE - to show that it was practical for Industry and MoD to combine efforts to build and also to demonstrate that they could add value to defence products and processes

- Led to formulation of the National Capability Demonstrator programme. Many topics suggested, including interestingly some which went far outside the confines of defence (eg. Management of Civil Crises)

Notes for Slide 29

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Led to formulation of the National Capability Demonstrator programme. Many topics suggested, including interestingly some which went far outside the confines of defence (eg. Management of Civil Crises)

National Capability Demonstrators (NCDs)

- NCDs were a joint initiative between a partnership of UK Industry and the MoD.

- They were more than simply Technology demonstrations; they aimed to show how, as a process, Synthetic Environments (SEs) could reduce time, risk and cost during the equipment acquisition cycle.

- NCDs shared two common objectives:
  - first, to show that MoD and a wide range of Industry partners could collaborate to build SEs (the choice of partners varied for each NCD), and
  - second, to show how SEs could add value to chosen equipment programmes.

Notes for Slide 31

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MoD/Industry Collaboration Timeline

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	US/UK Synthetic Theatre of War Programme								
SEMB forms									
	NCD - FlasHLAmp								
		NCD - ADSE							
	Virtual Ship; Project Vitesse								
				NCD - SeBA					
				FOAS					
			NIREUS						
					EUCLID 11.13				

Notes for Slide 33

This slide aims to show the timeline.

Project FlasHLAmp NCD (1996-98)

- A MOD Beacon Funded Project
  - Beacon was an Integrated MOD/DERA/Industry programme with shared costs
- Project Goal
  - *To provide MOD/DERA/Industry with an understanding of the use, development and application of the US High Level Architecture (HLA) and thus provide information and experience to exploit the potential benefits of HLA for compatibility, interoperability and software re-use*

Project FlasHLAmp Partners

INDUSTRY

CORDA

Data Sciences Ltd

EASAMS

EDS

Logica

CAE Invertron

GEC Marconi

Headway Consultants

Matra BAe Dynamics

Primary Image

Thomson Training and Simulation

DERA

Portsdown (CDA)

Bedford (Air Systems)

Chertsey (Land Systems)

Malvern (CIS/SP)

Notes for Slide 36

This demonstrates the breadth of expertise involved.

Project FlasHLAmp Conclusions

- Fostered good working relationships with UK industry

- The DMSO programme was working. However, the HLA did not answer all the questions surrounding Simulation Interoperability and re-use

- Development of UK RTI established a UK voice within US AMG and IEEE HLA

- An awareness of the HLA, underpinned by real experience, aided strategic planning

Air Defence SE (ADSE) (1998)

- The primary goal of ADSE was the development of a validated set of networked simulation assets representing current and future ground based Air Defence (AD) systems and associated environment.

- One of the primary goals of the programme was to ensure that, where possible, the owners of the AD real systems and associated simulation assets be responsible for their development, validation and support at their home sites. This inevitably resulted in the requirement to create a Wide Area Network (WAN) interconnecting many sites across the UK.

Air Defence SE (ADSE) (1998)

RAP Feed

Rapier FCC

Rapier FUs

FADC

ADCIS Messages

HVM FCC

HVM FUs
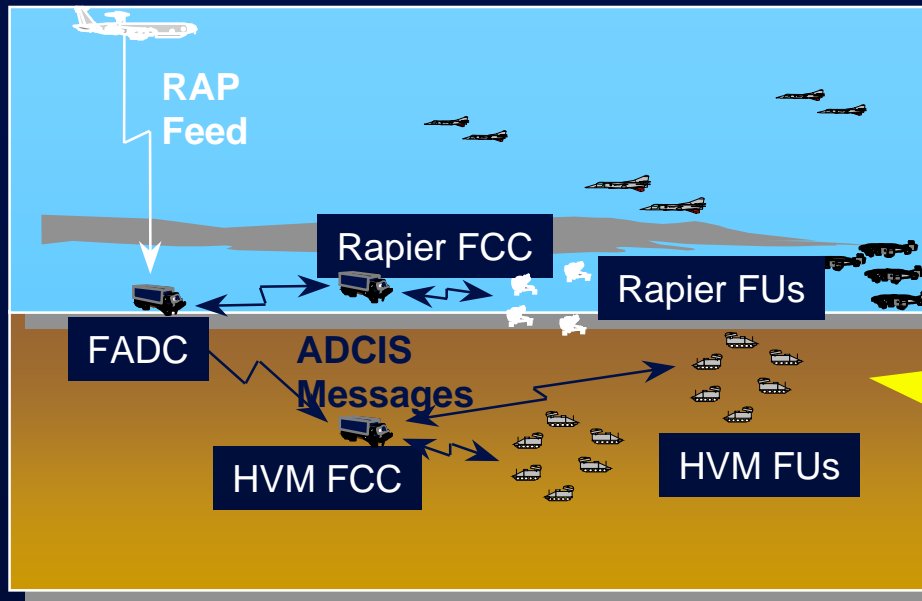
realistic scenario real users
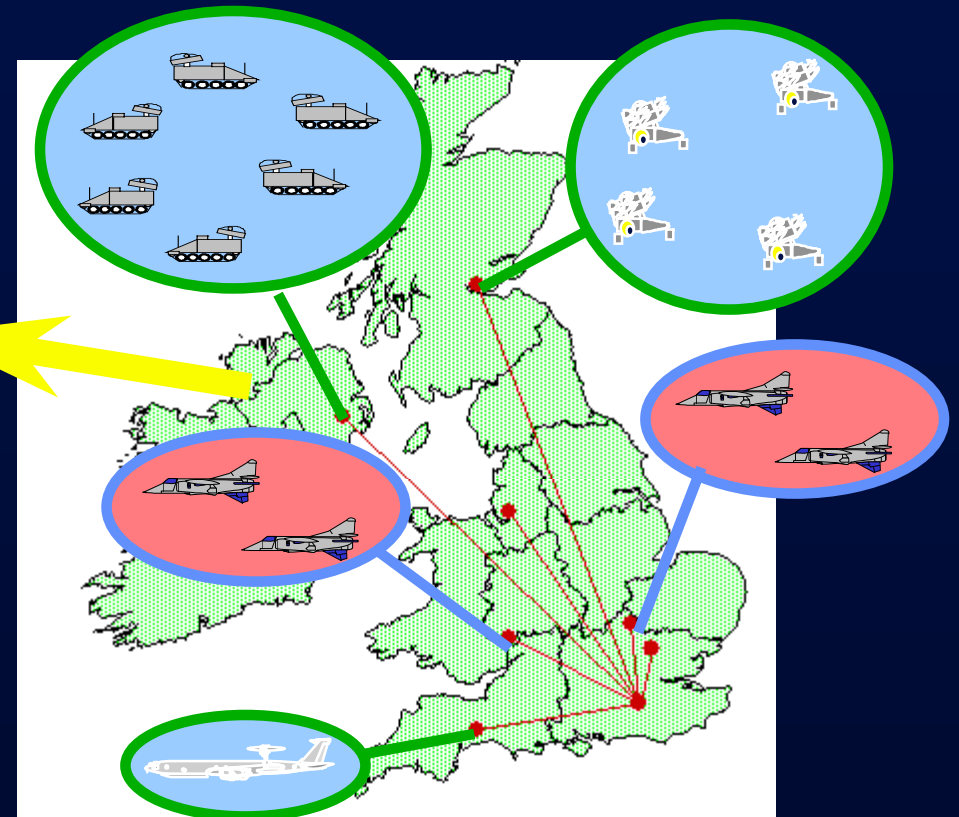
Notes for Slide 40

Message:

Practical demonstration of an SE that added value to defence products and activities.

Over the last 3 years we have run a programme of research and demonstrations, jointly with UK Industry and our allies (especially the US), designed to refine the technology, tailor it to user needs and examine what has been gained.

One of the most important demonstrations has been the Air Defence SE or ADSE. The picture shows what ADSE was - models and simulators of Rapier and High Velocity Missile systems, defending a deployed Division against fixed and rotary wing attack within a tactically realistic scenario.

The simulations were located at various sites across the UK and were manned by Serving military personnel. ADSE was designed to address 3 key issues:

- • Practicality
- • Affordability
- • Value.

The conclusion reached was that ADSE proved technology and benefit in using a Distributed Interactive Simulation to answer a pertinent and relevant OR question namely "Does the introduction of Recognised Air Picture 9RAP0 contribute to the effectiveness of UK GBAD?"

Air Defence SE - lessons learnt

- **Practical**
  - Built within 6 months. Worked first time - although contractual issues problematical

- **Affordable**
  - About 10% cost of live exercise - shared with Industry

- **Valuable**
  - Judged to be highly realistic by service users
  - Appraisal of Recognised Air Picture in current C3I architecture in a high-intensity scenario
  - A flexible and highly effective tool for concept formulation, evaluation., Requirements Capture, Doctrine development and collective training
  - An Integrated Product team in action.

Notes for Slide 42

Message: Are SEs practical? Doubters said beforehand that even if the technical problems could be overcome, Industry would never allow its models and simulations to be used in such a fashion - MoD and competitors would learn too much about commercial secrets and things that individual firms would prefer to keep to themselves. In fact, once DERA and the 8 firms involved accepted that they all had something to gain, IPR and commercial problems could be solved. Furthermore from the technical view, the network and its representation of the world and the participating units were built within six months - and it worked first time and kept working.

Are they affordable? We achieved a total battlefield test at Divisional level at around 10% of the cost of doing it for real - even if the real forces had been available. Furthermore, industry was happy to pay half the costs.

What was the value? In the opinion of the commanders and Air Defenders who took part ADSE gave them the closest approach to combat that it is possible to get outside the real thing - it provided genuine hands-on user experience. The scenario was fully credible and intensive enough to allow a real military problem to be addressed (the utility of providing a Recognised Air Picture). ADSE proved itself a good (and unique) tool for concept formulation, evaluation, requirements capture, doctrine development and collective training. Furthermore it showed an Integrated Product Team in action looking at the complex area of C3I architecture.

After ADSE....
Integrated Ground Based Air Defence

- Early assessment:
  - Human Factors.
  - Industry collaboration.
  - Developing common view of problem space
  - …..and solution space.

- Assessment Phase
  - IPT taking through life approach to M&S
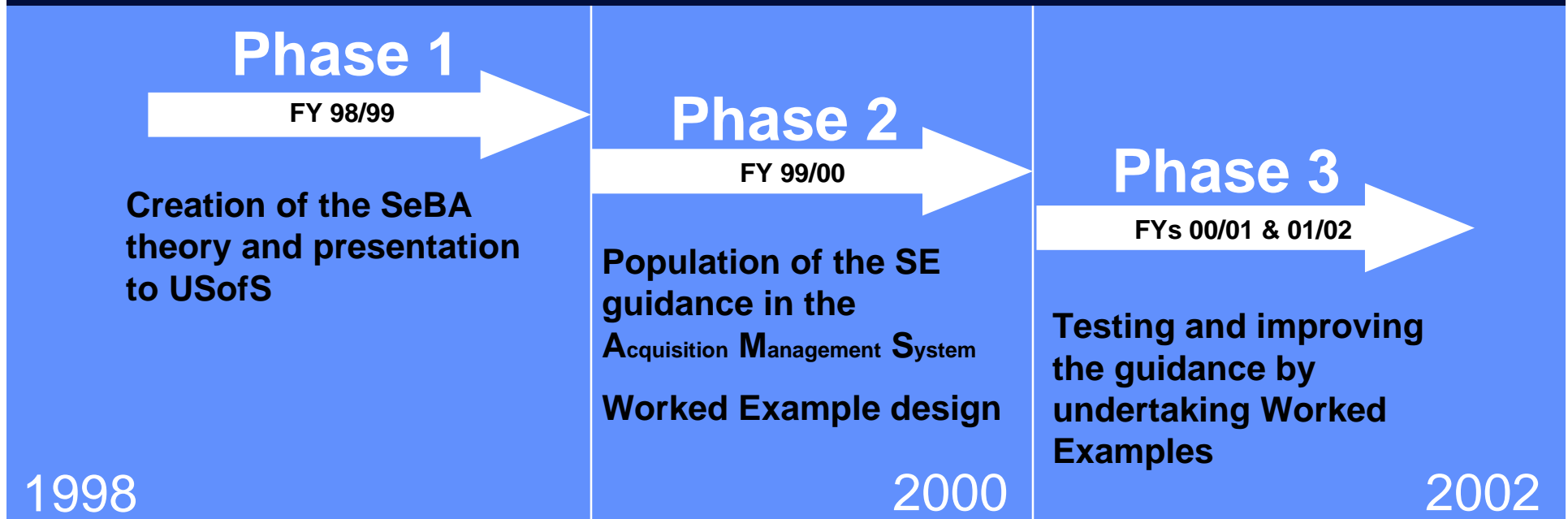
Notes for Slide 44

Evidence that working with Industry can pay off is that early in the "real" GBAD project Industry used SE techniques to explore options. We now have the MOD looking to set up an SE to assess competing bids for the C4I integration work.

SE-Based Acquisition NCD - SeBA

- Capturing knowledge and best practice on the application of integrated M&S to UK Defence equipment acquisition.
- Ascertaining the benefits of a SeBA approach.
- Joint MoD / Industry team.

Phase 1

FY 98/99 →

Creation of the SeBA theory and presentation to USofS

Phase 2

FY 99/00 →

Population of the SE guidance in the Acquisition Management System

Worked Example design

Phase 3

FYs 00/01 & 01/02 →

Testing and improving the guidance by undertaking Worked Examples

1998   2000   2002

Notes for Slide 46

Research started in 1998.
- 50/50 funded with Industry.
- £1.3M govt over 4 years.

Coincided with launch of Smart Acquisition.
- Much of the initial theory was included in the Smart reforms.

Development of the theory was easier than testing it.
- Worked Examples seen as essential to prove before publishing.
- In practice, uptake of SeBA ideas has happened before the research is complete.

Mixed funding induces risks and delays.
- No direct control over resources.
- Business managers want to see the benefits and fiscal return on R&D efforts within 3 years of initial investment.

SeBA

- Generated Guidance

- Built up Expertise in MoD and Industry

- Shown MoD and Industry can work on research project

- Improve understanding of MoD process

- Issues

  – Balance between MoD and Industry

  – Are we fighting the same war?

Future Offensive Air System (FOAS) SE - 2000

- The FOAS SE Demonstration Project was a collaborative, jointly funded project involving MoD/DERA (Defence Evaluation & Research Agency), MoD/DPA (Defence Procurement Agency), MoD/Deep Strike, MoD/SECO (Synthetic Environments Co-ordination Office) and UK Industry. The industry partners included:

  - Aerosystems International (AeI),

  - Alenia Marconi Systems (AMS),

  - BAE Systems Warton,

  - BAE Systems Avionics,

  - British Telecom (BT) Defence, CORDA,

  - Matra BAe Dynamics UK Ltd (MBD) and

  - Thales Training & Simulation (TT&S).
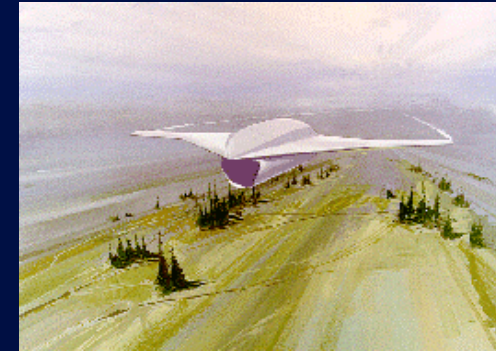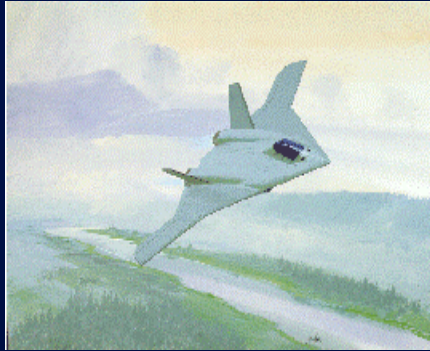
Notes for Slide 49

Service - RAF

Description

The FOAS programme aims to provide the UK with a long-range offensive air capability to replace that currently provided by Tornado GR4.

This was another MoD/Industry collaboration.

Future Offensive Air System

- Joint MoD/Industry Demonstration Experiment July 2000
    - "What are the effects on tactics and system effectiveness of changing the roles (and capabilities) of Uninhabited Air Vehicles within a FOAS Force Mix?"
    - Investigate using a mixed man-in-the-loop and purely constructive mission simulation to support assumptions made during statistical Operational Analysis techniques

FOAS SE Statistics

- Real Time - Man in the Loop

- Classified WAN over 3 sites

- 24 Discrete Federate Systems
  – 18 simultaneous federates

- 36 Missions completed
  – 10 base mission types

- Minimum Resources Required
  – 2 aircrew, 4 observers, 4 operators, 2 support

- Over 400 Air & Surface Entities

**BAE SYSTEMS
Warton**

**Matra BAe
Dynamics**

**DERA
Farnborough**
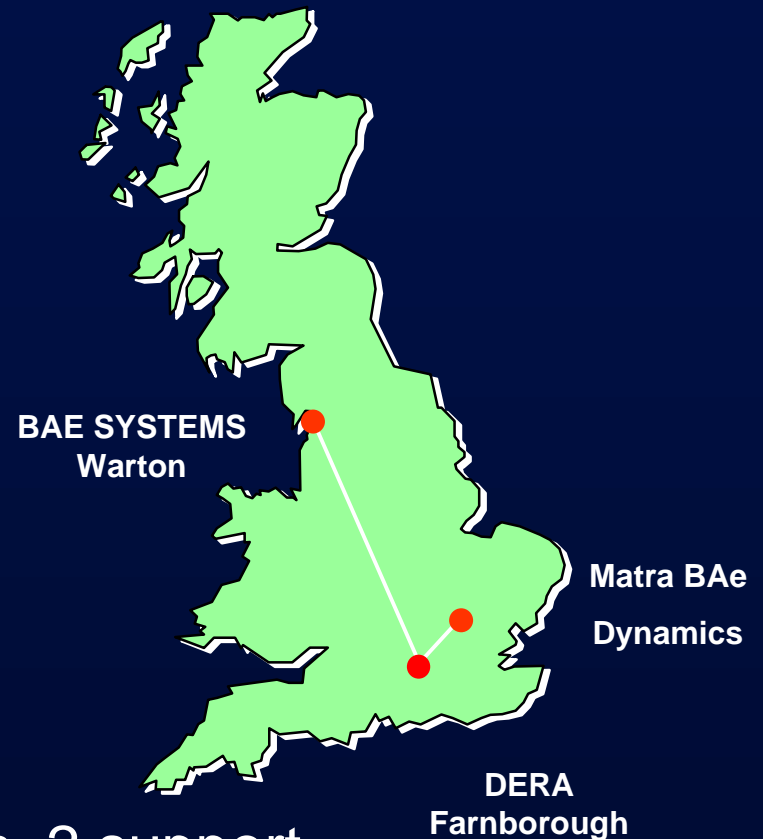
Notes for Slide 52

Significant experiment - approach is now being taken forward by the FOAS Project in partnership with the Joint Combat Aircraft Project.

UK Project VITESSE - Overview

- Customer
  - Director Naval Architecture / MOD(PE)
- The Project
  - a man-in-the-loop DIS simulation of workers moving, arming and refuelling aircraft on a new design of Aircraft Carrier over a LAN and
  - testing the take-off and landing using remote aircraft simulators communicating over a WAN.
- 'Integrated project team'
  - managed by DERA
  - technical contributions from DERA & Industry (BAe Military Aircraft, Graphics Research Corporation (GRC), Marconi Marine, Matra BAe Dynamics (MBD), Silicon Graphics, Systems Engineering & Assessment (SEA))

Project VITESSE Participants

BAe Warton CTOL Simulation to CV(F)

DERA Bedford STOVL Simulation to CV(F) and CVSG

DNA MoD(PE) / SEA North Bristol CV(F), CVSG Simulation

Matra BAe Dynamics, Stevenage DIS Hub

EUCLID 11.13 OVERVIEW

- ## Euclid
    - **EU**ropean **C**o-Operation for the **L**ong-term **I**n **D**efence
    - Collaborative, pre-competitive research programme

- ## Customer
    - Western European Union Armaments Group (WEAG) study funded by 13 National MoDs
    - Representatives from each MoD form Management Group
    - UK MoD (Dstl) Chair Management Group

- ## Programme details
    - €17M Euros funded by MoD and Industry
    - Duration - November 2000 to October 2003
    - Primed by Thales Training & Simulation (UK)
    - Management Committee comprising of 9 Work Package Managers

Notes for Slide 56

We are of course now also working with Industry together with our Allies in this ambitious EUCLID Project.

MoD/Industry Collaboration Timeline

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
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SEMB forms									
	NCD - FlasHLAmp								
		NCD - ADSE							
	Virtual Ship; Project Vitesse								
					NCD - SeBA				
				FOAS					
			NIREUS						
					EUCLID 11.13				

Notes for Slide 58

This slide aims to show the timeline.

Working together...

Notes for Slide 60

To illustrate this co-operation we have put together a few videos.

Other MoD/Industry Co-operation

- DEC/IPT/SECO Bi-laterals

- DEC/IPT/SECO Industry Days

Notes for Slide 62

There are other important methods of communicating...

Current MOD/Industry SE Bodies

- Synthetic Environments Management Board (SEMB)

- SEMB NAC

- SeBA Forum

Notes for Slide 64

I will now talk about the present day - here are our main MOD-Industry forums...

Synthetic Environments Management Board (SEMB)

- Since 1995 the SE Management Board (SEMB) has been the UK's steering committee for SE development and exploitation

- It is chaired by a representative from UK Industry and has membership from MOD, Industry and Academia

- It approves joint work between Government and Industry (eg. The National Capability Demonstrators)

- The SEMB also acts as the National Advisory Council (NAC) for SE research in response to the UK Government's Foresight initiative

- The SEMB maintains a web site at www.semb.co.uk.

Benefits - An Industry View

- **UK MoD**
  - Support to Smart Acquisition
  - Reuse of models, analysis
  - Train as you will fight
  - Managed Risk
  - Common views with industry
  - Addresses whole life costs

- **Industry**
  - Leverage internal investment in M&S
  - Influence
  - Managed Risk
  - Common views with MoD
  - Customer support
  - Re-use of models, techniques etc.

SEMB

Agreed NAC SE Research Strategy

Required Areas of Improvement (poc)

– Synthetic Natural Environment (Thales)

– Computer Generated Forces (BAE)

– SE Comms/Networks (MoD)

– SE Security (eg. access to cryptos) (MoD)

– SE Process (eg. VV&A) (BAE)

– SE Management (eg. data tools) (EUCLID)

- Towers of Excellence

  – "SEs" will be launched as a "Batch 1 Tower"

Key Towers of Excellence Principles

Desired Outcome:

– The establishment, maintenance and continual improvement of MoD's and Industry's technological excellence in a defined focus area, coupled with the transfer of that technology to which MoD has rights to the pertinent defence equipment supplier base.

The Three Essential ToE Characteristics:

– The Towers are decided upon in consultation with Industry and Academia

– A science and technology plan for the focus area, decided upon in consultation with Industry and Academia Tower partners.

– A technology transfer and exploitation mechanism, for the focal area, decided upon in consultation between MoD stakeholders, industry and academia.

SE Based Acquisition (SeBA) Forum

- The SeBA Forum will facilitate the implementation, and continue the joint Industry/MOD evolution of SeBA, share information concerning best practice, and promote the integrated use of SE, M&S, throughout acquisition.

- Two meetings thus far in 2002 (attendance at last meeting:- AeI; Alvis vehicles; AMS; CORDA; CTS; LARO; DPA/PDG; Dstl; FSL; LSC Group; MBDA; NNC; QinetiQ; RMCS; SECO; Thales)

Summary

- UK Approach to Synthetic Environments and M&S

- Why Work with Industry?

- Historical Perspective

- Current Arrangements

Questions

Working with Industry – The UK MoD Experience

Mr Andrew J. Fawkes
Head of the Synthetic Environments Co-ordination Office
MOD/UK/SECO – DG(R&T)
Room 601 – Northumberland House
London WC2N 5BP
UNITED KINGDOM

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